In [1]:
```
# !pip install kaggle
```

In [2]:
```
# !mkdir ~/.kaggle
```

In [1]:
```
!pwd
```

```
/Users/harvey/Documents/Studies/Computer Science/Deep Learning/HW1P2
```

In [2]:
```
# !kaggle competitions download -c idl-fall2021-hw1p2
```

In [3]:
```
# !unzip idl-fall2021-hw1p2.zip -d Data/
```

In [4]:
```
# !conda install matplotlib
```

Global Settings

In [36]:
```
GLOBALTEST = False
```

In [37]:
```
import numpy as np
import torch
import torch.nn as nn
import matplotlib.pyplot as plt
import torch.nn.functional as F
import time
import torch.optim as optim

from torch.utils import data

%matplotlib inline
```

In [38]:
```
cuda = torch.cuda.is_available()
if cuda: print("Using cuda!!")
else: print("No cuda available")
```

```
No cuda available
```

Loading Data

In [72]:
```
real_paths = ["Data/train.npy", "Data/train_labels.npy", "Data/dev.npy", "Data/d
toy_paths = ["Data/toy_train_data.npy", "Data/toy_train_label.npy", "Data/toy_va

paths = toy_paths

train_data = np.load(paths[0], allow_pickle=True)
```

```
train_label = np.load(paths[1], allow_pickle=True)
test_data = np.load(paths[2], allow_pickle=True)
test_label = np.load(paths[3], allow_pickle=True)
```

In [73]:
```
print(train_data.shape)
print(train_data[0].shape)
```

```
(1000,)
(1184, 40)
```

In [74]:
```
print(train_label.shape)
print(train_label[0].shape)
```

```
(1000,)
(1184,)
```

In [75]:
```
train_data = train_data[:]
train_label = train_label[:]
test_data = test_data[:]
test_label = test_label[:]
```

Dataset

In [76]:
```
from dataset import MyDataset
```

Dataloader

In [77]:
```
num_workers = 4 if cuda else 0
context_size = 10

# Training
train_dataset = MyDataset(train_data, train_label, context_size = context_size)

train_loader_args = dict(shuffle=True, batch_size=256, num_workers=num_workers,
                         else dict(shuffle=True, batch_size=64)
train_loader = data.DataLoader(train_dataset, **train_loader_args)

# Testing
test_dataset = MyDataset(test_data, test_label, context_size = context_size)

test_loader_args = dict(shuffle=False, batch_size=256, num_workers=num_workers,
                         else dict(shuffle=False, batch_size=1)
test_loader = data.DataLoader(test_dataset, **test_loader_args)

del train_data
del test_data
del train_label
del test_label
```

In [78]:
```
print(len(train_dataset))
# print(list(test_loader))
```

```
1290844
```

Model and Loss Function

In [79]:
```
class Simple_MLP(nn.Module):
    def __init__(self, size_list):
        super(Simple_MLP, self).__init__()
        layers = []
        self.size_list = size_list
        for i in range(len(size_list) - 2):
            layers.append(nn.Linear(size_list[i],size_list[i+1]))
            layers.append(nn.ReLU())
        layers.append(nn.Linear(size_list[-2], size_list[-1]))
        self.net = nn.Sequential(*layers)

    def forward(self, x):
        return self.net(x)
```

In [86]:
```
model = Simple_MLP([40*(2*context_size+1), 90, 71])
criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.parameters(), lr = 1e-4)
device = torch.device("cuda" if cuda else "cpu")
model.to(device)
print(model)
```

```
Simple_MLP(
  (net): Sequential(
    (0): Linear(in_features=840, out_features=90, bias=True)
    (1): ReLU()
    (2): Linear(in_features=90, out_features=71, bias=True)
  )
)
```

Training Procedure

In [87]:
```
def train_epoch(model, train_loader, criterion, optimizer):
    model.train()

    running_loss = 0.0

    start_time = time.time()
    for batch_idx, (data, target) in enumerate(train_loader):
        optimizer.zero_grad()   # .backward() accumulates gradients
        data = data.to(device)
        target = target.to(device) # all data & model on same device

        outputs = model(data)
        loss = criterion(outputs, target)
        running_loss += loss.item()

        loss.backward()
        optimizer.step()

    end_time = time.time()
```

```
    running_loss /= len(train_loader)
    print('Training Loss: ', running_loss, 'Time: ',end_time - start_time, 's')
    return running_loss
```

In [88]:

```
def test_model(model, test_loader, criterion):
    with torch.no_grad():
        model.eval()

        running_loss = 0.0
        total_predictions = 0.0
        correct_predictions = 0.0

        for batch_idx, (data, target) in enumerate(test_loader):
            data = data.to(device)
            target = target.to(device)

            outputs = model(data)

            _, predicted = torch.max(outputs.data, 1)
            total_predictions += target.size(0)
            correct_predictions += (predicted == target).sum().item()

            loss = criterion(outputs, target).detach()
            running_loss += loss.item()


        running_loss /= len(test_loader)
        acc = (correct_predictions/total_predictions)*100.0
        print('Testing Loss: ', running_loss)
        print('Testing Accuracy: ', acc, '%')
        return running_loss, acc
```

Training

In [89]:

```
n_epochs = 5
save = True
Train_loss = []
Test_loss = []
Test_acc = []

for i in range(n_epochs):
    train_loss = train_epoch(model, train_loader, criterion, optimizer)
    test_loss, test_acc = test_model(model, test_loader, criterion)
    Train_loss.append(train_loss)
    Test_loss.append(test_loss)
    Test_acc.append(test_acc)
    if save:
        torch.save(model.state_dict(), "checkpoint.pth")
    print('='*20)
```

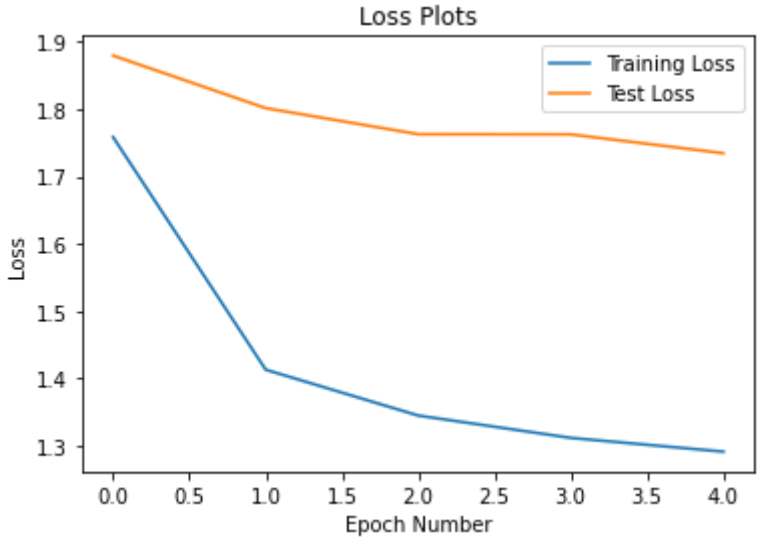
```
Training Loss:  1.758584875128443 Time:  56.29364466667175 s
Testing Loss:  1.8796482645530959
Testing Accuracy:  48.89762408444077 %
====================
Training Loss:  1.4132999059021563 Time:  56.114691972732544 s
```

```
Testing Loss:  1.8016678336814829
Testing Accuracy:  50.934546545790006 %
====================
Training Loss:  1.3451833833221403 Time:  56.33943510055542 s
Testing Loss:  1.7629492115241363
Testing Accuracy:  51.95078487090476 %
====================
Training Loss:  1.3120011769844626 Time:  55.746520042419434 s
Testing Loss:  1.7626723880907418
Testing Accuracy:  52.27644053542385 %
====================
Training Loss:  1.2916093026847018 Time:  56.033568143844604 s
Testing Loss:  1.7347410011363125
Testing Accuracy:  52.63284639352097 %
====================
```

Result Visualization

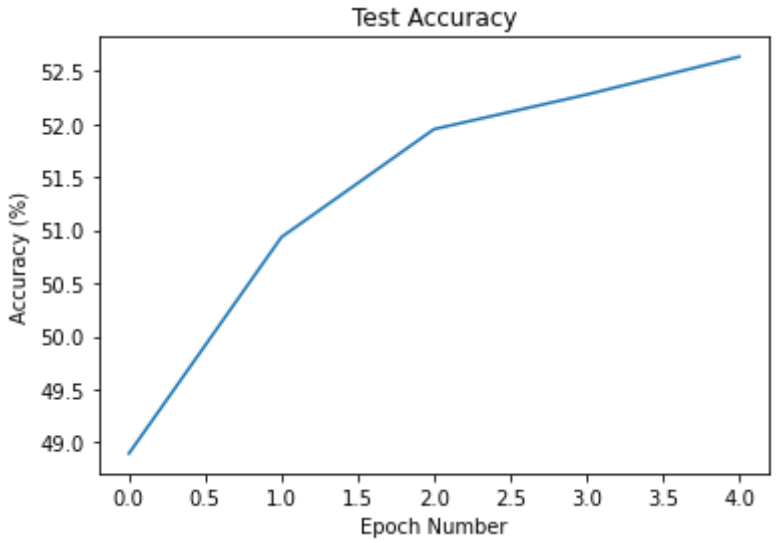
In [90]:

```
plt.title('Loss Plots')
plt.xlabel('Epoch Number')
plt.ylabel('Loss')
plt.plot(Train_loss, label='Training Loss')
plt.plot(Test_loss, label = 'Test Loss')
plt.legend()
plt.show()
```



In [91]:

```
plt.title('Test Accuracy')
plt.xlabel('Epoch Number')
plt.ylabel('Accuracy (%)')
plt.plot(Test_acc)
plt.show()
```


Test Accuracy
Accuracy (%)
52.5
52.0
51.5
51.0
50.5
50.0
49.5
49.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Epoch Number

In [ ]:

In [ ]: